

Appl. No.: 10/039,290
Amdt. Dated: 06/06/2005
Off. Act. Dated: 03/08/2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (original): An apparatus for providing non-contact thermal measurements at high spatial and thermal resolutions, comprising:

an illumination source;

means for generating a signal in response to registration of the magnitude of light received from said illumination source that is reflected from the surface of an object; and

means for generating a bandwidth-limited AC-component of the signal from said illumination detector while said object is subjected to modulated thermal excitation.

2. (original): An apparatus for providing non-contact thermal measurements at high spatial and thermal resolutions, comprising:

an illumination source;

an array of individual illumination detectors;

said illumination detectors configured to generate signals in response to registration of the magnitude of light received from said illumination source that is reflected from the surface of an object; and

a signal processor;

said signal processor configured to filter one or more direct current components from said signal while said object is subjected to modulated thermal excitation to discern a small thermorefectance signal from noise.

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3. (original): An apparatus as recited in claim 1, wherein said means for generating a signal in response to registration of the magnitude of light received from said illumination source that is reflected from the surface of an object comprises:
an array of individual illumination detectors.

4. (original): An apparatus as recited in claim 3, wherein:
said array of illumination detectors is adapted to generate information on the intensity of light received by each of said individual illumination detectors in the array.

5. (original): An apparatus as recited in claim 1 or 2, further comprising:
a display;
said display adapted for displaying a bandwidth-limited AC-component of the signal.

6. (original): An apparatus as recited in claim 1 or 2, further comprising:
means for receiving a bandwidth-limited AC-component of the signal and
computing a thermal measurement based on a change in registered surface reflectance.

7. (original): An apparatus as recited in claim 6:
wherein said object has a known thermorefectance constant; and
wherein said change in registered surface reflectance is in response to a change in the thermorefectance coefficient of the surface material of said object resulting from a temperature change associated with said thermal excitation.

8. (original): An apparatus as recited in claim 1 or 2, further comprising:
means for generating a superresolution image from a combination of thermal images having a lower spatial resolution.

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9. (original): An apparatus as recited in claim 8, wherein said means for generating a superresolution image comprises:
a computer; and
programming associated with said computer for,
receiving a plurality of thermal images having a first image resolution, and
combining said thermal images having said first resolution by interpolating pixel values into a thermal image having a higher second resolution.
10. (original): An apparatus as recited in claim 1 or 2, wherein said illumination source comprises a laser light source.
11. (original): An apparatus as recited in claim 10, wherein said laser light source operates at wavelength ranging from approximately 500 nm to approximately 800 nm.
12. (original): An apparatus as recited in claim 10, wherein said laser light source has a wavelength of approximately 655 nm.
13. (original): An apparatus as recited in claim 10, wherein said laser light source has an output power ranging from approximately 1 mW to approximately 100 mW.
14. (original): An apparatus as recited in claim 10, wherein said laser light source has an output power of approximately 5 mW.
15. (original): An apparatus as recited in claim 1 or 2, further comprising:
an x-y translation stage;

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said translation stage configured to provide motion to said illumination source and said illumination detector in relation to the surface of said object;

wherein a thermal image may be constructed from data collected during scanning of the surface of said object.

16. (original): An apparatus as recited in claim 15:

wherein said x-y translation stage comprises a piezoelectric translation stage;

wherein said translation stage provides movement resolution that is approximately equal to or higher than the desired spatial resolution at which the object is being measured.

17. (original): An apparatus as recited in claim 1 or 2:

wherein said illumination source is configured to generate a beam spot size that approximates, or is less than, the desired spatial resolution of thermal measurement.

18. (original): An apparatus as recited in claim 17, further comprising:

an inverse-filter which is applied to remove image blurring caused by an excessively large illumination spot size.

19. (original): An apparatus as recited in claim 1 or 2, wherein said illumination detector comprises a photodiode.

20. (original): An apparatus as recited in claim 2 or 3, wherein said array of illumination detectors comprises an array of photodetectors ranging in size from approximately 16 x 16 array to approximately 64 x 64.

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21. (original): An apparatus as recited in claim 2 or 3, wherein said array of illumination detector comprises an array of photodetectors ranging in size from approximately 2 x 2 to approximately 256 x 256.

22. (original): An apparatus as recited in claim 1 or 2, wherein the frequency range of said modulated thermal excitation to which said object is subjected ranges from approximately 0.1 Hz to approximately 100 kHz.

23. (original): An apparatus as recited in claim 1, wherein said means for generating a bandwidth-limited AC-component of the signal from said illumination detector while said object is subjected to modulated thermal excitation comprises:
a signal processor;
said signal processor configured to filter one or more direct current components from said signal to discern a small thermorefectance signal from noise.

24. (original): An apparatus as recited in claim 2 or 23, wherein said signal processor is selected from the group of narrow band filters consisting essentially of a lock-in amplifier, differential boxcar averaging circuit, and FFT analyzer.

25. (original): An apparatus as recited in claim 2 or 23, wherein said signal processor is configured to filter out components of the signal other than a single harmonic of the registered illumination level.

26. (original): A method as recited in claim 25:
wherein said single harmonic that is at, or associated with, the frequency of modulation to which said object is subjected.

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27. (original): An apparatus as recited in claim 2 or 23, wherein said signal processor is configured to pass a band of frequencies that is less than approximately 10 Hz.

28. (original): An apparatus as recited in claim 2 or 23, wherein signal processor has a passband having a maximum width of approximately 1 Hz.

29. (original): An apparatus as recited in claim 2 or 23, wherein said signal processor is configured to pass a band of frequencies that is limited to approximately 0.1 Hz.

30. (original): An apparatus as recited in claim 1 or 2, further comprising:
an imaging device adapted to receive a portion of the reflected illumination for aligning position of the illumination source in relation to the object.

31. (original): An apparatus as recited in claim 30, further comprising:
a splitter configured to direct portions of said reflected illumination to said imaging device.

Claims 32-39 (canceled)

40. (original): A method for providing high resolution thermal imaging of an object being subjected to thermal modulation, comprising:
illuminating an area on the surface of an object for which thermal information is desired;
detecting illumination reflected from said area; and
generating an AC-coupled bandwidth-limited signal in response to detected illumination.

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41. (original): A method as recited in claim 40:
wherein said AC-coupled signal has a bandwidth with a center at, or associated with, the frequency of modulation to which said object is subjected.

42. (original): A method as recited in claim 40, further comprising:
resolving the AC-coupled signal into an image.

43. (original): A method for providing high resolution thermal imaging of an object being subjected to thermal modulation, comprising:
illuminating an area on the surface of an object for which thermal information is desired;
detecting illumination reflected from said area;
generating an AC-coupled bandwidth-limited signal in response to detected illumination; and
resolving the AC-coupled signal into an image.

44. (original): A method as recited in claim 43:
wherein said AC-coupled signal has a bandwidth with a center at, or associated with, the frequency of modulation to which said object is subjected.

Claims 45-48 (canceled)